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ABSTRACT

The subjects used in this study were 202 second grade pupils, representing the entire population from nine classrooms in four school buildings all located in a middle-class town. Treatment conditions were used which modeled reward conditions: (1) a neutral, no-overt-reward condition in which the tester quietly observed the subject working at the tasks; (2) a condition in which rewards were delivered only for acceptable solutions to the task problem; (3) a condition in which reward was not necessarily congruent with task achievement and in which rewards were delivered on a fixed time schedule. The experimental tasks were categorization or sorting tasks which required the children to attend to various physical properties of objects and to group them dichotomously on the basis of these properties. Findings indicated that the use of verbal rewards which are not congruent with behavior will result in less efficient problem-solving then either a neutral, no-reward situation, or the use of rewards which are congruent with the problem-solving behavior. (BR)

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# THE EFFECTS OF VERBAL REWARD ON THE BEHAVIOR OF CHILDREN IN THE PRIMARY GRADES AT A COGNITIVE TASK TYPICAL OF THE NEW ELEMENTARY SCIENCE CURRICULA

by

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## Background of the Problem

Various studies of verbal interaction in classrooms indicate that when teachers react verbally to what a pupil does or says, this reaction is usually an evaluative comment. In a high percentage of cases this evaluation is positive; for instance, "Good," "O.K.," "That's right," "Fine," "Excellent." Bellack's results[1] indicate that whether the pupil is right or wrong, the teacher usually responds with a positive rewarding statement. The ratio of positive to negative reactions remained at four to one. This research was carried out in senior high school classrooms with social studies as the subject matter. Analysis of classroom tapes made in conjunction with research at the Science Curriculum Improvement Study (SCIS) Trial Center at Teachers College, Columbia University, indicates that the same rather fixed reward pattern is characteristic of many primary grade teachers conducting science lessons. Positive verbal rewards, given at times for "correct" responses and at other times apparently for "effort" are very much a part of the classroom scene regardless of age level or subject matter. The question then arises: What are the effects of such rewards upon the problem-solving behaviors of pupils in modern elementary science programs. In these programs problem situations are created wherein manipulanda have stimulus characteristics relevant to success or failure of the student's response. The stimuli are phenomena whose characteristics are directly observable. This is a departure from many earlier science programs

where the phenomena were encountered through a textbook and an occasional demonstration.

## The Literature

The literature on verbal reward indicates that the effects of such reward have been examined in two general areas. The first area is concerned with cognitive effects; in this research, contingent reinforcement has been used in the study of concept attainment. According to this approach reward functions as a guide to concept formation. Each "That is correct" or "That is wrong," although it may be an implicit reward or punishment, primarily transmits a certain amount of information toward the formation of a generalization. The second aspect of the research in this area is more concerned with the motivational effects of reward. This research examines the effects of verbal reward on persistence and rate of response in a motor task situation.

Although both of these research areas have classroom implications, neither of them gives a clear answer to the problem proposed here, namely to determine the effects of verbal reward upon problem solving in a cognitive task situation. On the other hand, the informational value of teacher rewards is frequently ambiguous -- what is being rewarded, the response or the effort? On the other hand, it is difficult to say that because rewards given during a marble-dropping task increase motor response rates and persistence times, analogous effects will be encountered in those classroom task situations which do not happen to be motor tasks.

There are two assumptions which seem to be implicit in the reward giving behavior of teachers as it has been observed in classrooms: first, when students are rewarded in the classroom for correct responses they will be correct more often in the future; and second, when rewarded for effort, even though the response was incorrect, they will be more highly motivated to persist in learning situations. As noted above, the literature does not clearly support either of these assumptions. The basic postulate made here is that reward strategies must be appropriate to the educational task.

## New Science Curricula

A great deal of effort in science education during the past decade has been put into the development of curricula which have as an implicit and basic assumption the idea that the manipulation of objects and systems is both intrinsically motivating and has informational value. Perhaps this idea did not begin with the PSSC curriculum and its descendants, but it certainly has been basic to the "new science" movement. If, in science education,we are committed to the idea that students should obtain tentative answers by working with the real world rather than gathering fixed sets of conclusions from some authority, then the role of the verbal reward in our teaching strategies is of prime importance. The specific question asked in the present research is: What are the effects of various types of verbal reward on the problem-solving behavior of young children working at a task typical of the new

elementary science curricula?

## Theoretical Considerations

Research by Atkinson and others[2] indicates that problem-solving activity has a certain intrinsic motivating aspect if the subject foresees that performance is instrumental to producing a feeling of pride in accomplishment. This is achievement motivation. If, on the other hand rewards are delivered to the problem-solver from a human source, these may function as affiliation cues which may then become more prominent in the problem-solving situation than achievement motivation. When this happens, the subject may begin attending to cues which are extrinsic to the problem and his cognitive problem-solving activity will be less effective. These considerations suggest a basis for the prediction of possible outcomes in a reward situation where the task involves cognitive activity. In such a task situation, verbal rewards given to the subject by the experimenter will result in lower achievement than an attitude of quiet attention on the part of the experimenter.

In the tasks used in this research, achievement could be measured in several ways: 1) Total number of solutions; 2) number of acceptable solutions; 3) the ratio of acceptable solutions to total solutions (the E Ratio); 4) perseverance time; 5) number of seconds per solution; 6) sequence of solutions. Since the theoretical position suggests that the reward condition leads the attention of the subject away from the cues inherent in the problem

materials, we might expect that the rewarded subjects would be less efficient problem-solvers. That is, the rewarded subjects may work hard for rewards, coming up with many solutions, but, since their focus is external to the problem, a greater number of these solutions will represent random activity. The rewarded subjects will show relatively low E Ratios.

## Procedure

Treatment conditions were used which modeled the reward conditions which seem to occur in the classroom: 1) A neutral, no-overt-reward condition in which the tester quietly observed the subject working at the tasks; 2) a condition in which rewards were delivered only for acceptable solutions to the task problem, that is, for dichotomous sortings based on properties of the test objects (Pertinent Reward); 3) a condition in which reward was not necessarily congruent with task achievement, in which rewards were delivered on a fixed time schedule (Non-Pertinent Reward). This last condition is most analogous to observed classroom practice.

The subjects used in this study were 202 second grade pupils. They constituted the entire second grade population in a suburban shcool district. They were from nine classrooms in four school buildings all located in a town which is middle class according to the criteria developed by Warner, Meeker and Eells.[3]

The experimental tasks were categorization or sorting tasks which required the children to attend to the various physical properties of objects and to group them dichotomously on the basis

of these properties. The tasks were typical of those used on the first grade level in "Science A Process Approach" (AAAS),[4] "Material Objects Unit" (SCIS),[5] and "Attribute Games and Blocks" (ESS).[6] One experimental task, the Wood Block Task, developed by the investigator, consists of sixteen wooden blocks in two colors, two sizes, two thicknesses, two surface textures, and two surface details. The other experimental task, People Blocks, is a modification of the ESS material consisting of sixteen plastic pieces imprinted with human figures designed to differ on six dimensions: fat-skinny, red-blue, tall-short, boy-girl, arms and facial detail.

Testing was carried out by eight testers, four male and four female, graduate students in psychology or in science education. They were not informed of the experimental hypotheses in order to avoid a possible "Rosenthal Effect." They were trained in the experimental procedures before testing began.

Each subject was randomly assigned to one of three treatment conditions and to one of the testers. Each subject was tested individually. The testing time for each subject averaged about ten minutes. One-half of the subjects had had one full year of the SCIS program in first grade. A preliminary sorting task was used in order to screen out subjects who were unable to categorize objects dichotomously on the basis of properties. Eleven subjects were eliminated from the sample on the basis of this screening task. Each subject worked on both experimental tasks with the order of presentation randomized. The initial reward condition was maintained for both tasks. The testers recorded the following information:

Perseverance time on each task, the sequence of sortings, the number of rewards, and the verbalizations of the children describing their sortings. A fixed sequence of rewards was used which included both task rewards, such as "That's very good," and personal rewards, such as "You know how to do this." The testing was monitored by the investigator and audio-tapes were made of each testing session.

## Statement of Hypotheses

1. One of the effects of verbal reward, observed in motor task research, was to increase the number of responses of the rewarded subjects. The Total Number of Solutions score represents the number of responses made by each subject. The position taken in the present research is that subjects in a reward condition will react by attempting a greater number of solutions. This hypothesis stated in the null form is:

> The mean Total Number of Solution scores under the three reward conditions are equal.

2. Concept formation research would indicate that rewards given for acceptable responses will result in higher numbers of acceptable solutions. However, the informational value of rewards may be vitiated in certain tasks which involve close attention to materials and for which contingent reward is not essential for concept attainment. Therefore, the reward conditions, rather than facilitating acceptable problem solution, will result in fewer

acceptable solutions than the neutral condition. In the null form this hypothesis is stated as follows:

The mean Total Number of Acceptable Solution scores under the three reward conditions are equal.

3. In view of the theoretical position taken in this research, as stated above, the E Ratio is a key indicator of the effects of verbal reward in the task situation represented in the present experiment. It was predicted that the E Ratio would be low under reward conditions and high under the no-reward condition. Stated in the null form this hypothesis is:

The mean E Ratios under the three reward conditions are equal.

4. Motor task research suggests that increased motivation und under reward conditions results in longer perseverance times and faster response rates. Since the effects of reward are looked upon in the present study as strongly task dependent no such increases are postulated. Therefore, the following null hypotheses were tested:

a) The mean Perseverance Time scores under the three reward conditions are equal.

b) The Seconds per Solution scores under the three reward conditions are equal.

5. Since a pre Test was used to eliminate from the Test population the effects of prior experience with the problem task, we would expect equal categorization ability among those who previously had the SCIS program and those who had not had this experience. Therefore, the following null hypotheses were tested:

a) The Number of Acceptable Solutions scores of the two

experience groups are equal.

b) The mean E ratios of the two epperience groups are equal.

6. The performance of SCIS experienced subjects will be less subject to the influence of the reward conditions. Thss effect is hypothesized because the teachers using SCIS have been trained, on the basis of preliminary research carried out by Rowe[7] to give few verbal rewards when children are solving problems with SCIS materials If their teachers have been following this practice, the SCIS experienced subjects may react differently to the reward conditions of the present research. Thus, it is hypothesized that there will be interactions between reward conditions and SCIS experience on the dependent variables.

Analyses of variance and covariance were used to evaluate the data. An alpha level of .05 was chosen for significance. The following experimental design was employed:

| Reward Condition | Sex of Tester | Sex of Subject | No Reward | | Non-Pertinent | | Pertinent | |
|---|---|---|---|---|---|---|---|---|
| 1st Grade Science | | | SCIS | Other | SCIS | Other | SCIS | Other |
| | Male | Male | 7 | 10 | 7 | 9 | 7 | 8 |
| | | Female | 5 | 6 | 6 | 5 | 7 | 6 |
| | Female | Male | 8 | 11 | 9 | 5 | 10 | 7 |
| | | Female | 10 | 13 | 9 | 9 | 8 | 9 |

**FIGURE 1**

Research Design Employed in the Investigation

With Numbers of Subjects Tested in Each Category

## Results

Of the 191 subjects who were tested, 108 were tested by female testers and 83 by males. There were 98 male subjects and 93 female subjects. There were 98 subjects who had SCIS in first grade, 93 us used the district science program in first grade. Seventy subjects were assigned to the No Reward condition, 59 to the Pertinent Reward condition, and 62 to the Non-Pertinent Reward condition. Of the subjects, 103 worked on the People Blocks as the first task and 87 had the Wood Blocks first.

In order to determine whether or not the testers were behaving in a uniform manner, an analysis was made of the number of rewards delivered per minute by each tester under each of the two reward conditions considered separately. Table I indicates that the mean number of Pertinent Rewards delivered per minute by the eight testers was 1.552 with a standard deviation of .514 and a range of from .762 rewards per minute to 2.07 rewards per minute. The mean number of Non-Pertinent Rewards delivered perminute, as expected, was slightly higher, 1.964, with a standard deviation of .541 and a range of from 1.554 rewards per minute to 2.586 rewards per minute. The null hypothesis for the analysis of variance carried out on this data indicated that there is no difference between the means on reward behavior of the testers in each reward condition considered separately. Table II indicates that the F-Ratio values in both reward conditions are less than P= .99. The null hypothesis may be accepted: the eight testers were behaving in a comparable manner as far as the delivery of verbal rewards is concerned.

TABLE I

NUMBER OF REWARDS DELIVERED PER MINUTE BY EACH TESTER IN EACH REWARD CONDITION

| | | Testers | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Reward Conditions | | 1 | 2 | 2 | 4 | 5 | 6 | 7 | 8 |
| Pertinent Reward | | | | | | | | | |
| | N = | 4 | 10 | 11 | 10 | 5 | 8 | 5 | 6 |
| | Mean | 1.04 | 1.17 | 2.07 | 1.63 | 1.43 | 1.96 | 1.85 | .76 |
| | SD | .11 | 1.92 | .74 | .68 | .43 | .85 | .17 | .54 |
| Non-Pertinent Reward | | | | | | | | | |
| | N = | 9 | 10 | 13 | 8 | 5 | 9 | 2 | 6 |
| | Mean | 1.68 | 1.55 | 2.23 | 1.86 | 1.94 | 2.54 | 1.99 | 1.70 |
| | SD | .20 | .36 | .70 | .30 | .73 | 1.07 | .43 | .41 |

N = number of subjects

TABLE II

ANALYSIS OF VARIANCE FOR NUMBER OF REWARDS DELIVERED PER MINUTE IN TWO REWARD CONDITIONS

| Reward Conditions | Source Variance | Sums of Squares | df | Mean Square | F Ratio |
|---|---|---|---|---|---|
| Pertinent Reward | Total | 1198.7 | 58 | | |
| | Between Means | 11.10 | 6 | 1.850 | |
| | Within Groups | 1187.6 | 42 | 28.28 | .065 n.s. |
| Non-Pertinent Reward | | | | | |
| | Total | 2050.8 | 61 | | |
| | Between Means | 30.28 | 6 | 5.04 | |
| | Between Groups | 2020.5 | 55 | 36.74 | .137 n.s. |

Note: See Table I for means and standard deviations.

We asked above whether the testers were behaving in a similar manner to each other. There is a question which logically follows this, namely: "Were the subjects reacting in a similar manner across testers?" An answer to this question is supplied in Table III in terms of the five major dependent variables. This table indicates the number of subjects tested by each tester and the means for each group. A one-way analysis of variance was carried out on this data for each dependent variable. Table IV gives the results of this analysis. The null hypothesis that the means of groups of subjects tested by each tester do not differ would be rejected at an alpha level of .05 by an F-ratio value of 2.09 with 7 and 183 degrees of freedom. The F-ratios calculated indicate that the null hypothesis should be accepted for all dependent variables. That is, there are n no differences between the means of the groups tested by each tester.

Tables V, VI, and VII display the results which are pertinent to the first five experimental hypotheses. These hypotheses refer to the effects of the experimental conditions upon the five dependent variables used to measure performance on the tasks. These results are displayed for each task and for the combined tasks.

Hypothesis 1, Total Number of Solutions: The null hypothesis must be accepted for the means of subjects in each of the reward conditions for this variable. Subjects who were rewarded did not show a greater number of responses than the non-rewarded subjects.

Hypothesis 2, Number of Acceptable Solutions: The null hypothesis must again be accepted. None of the reward conditions resulted in a significantly greater number of acceptable solutions.

TABLE III

COMPARISON OF PERFORMANCES WITH EACH TESTER ON COMBINED TASKS

| Dependent Variables | | Testers 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N = | 20 | 30 | 41 | 26 | 17 | 28 | 9 | 20 | |
| Total Number of Solutions | Mean | 11.45 | 10.00 | 10.93 | 9.60 | 8.70 | 9.21 | 10.22 | 12.50 | |
| | SD | 6.86 | 3.86 | 6.34 | 4.31 | 3.92 | 3.51 | 2.86 | 5.40 | n.s. |
| Number of Acceptable Solutions | Mean | 8.90 | 7.83 | 7.02 | 7.19 | 6.70 | 8.00 | 9.22 | 7.95 | |
| | SD | 3.21 | 3.23 | 4.61 | 3.11 | 3.11 | 3.04 | 2.63 | 4.44 | n.s. |
| Efficiency Ratio | Mean | .777 | .783 | .642 | .749 | .770 | .869 | .902 | .636 | |
| | SD | .170 | .181 | .319 | .234 | .298 | .152 | .123 | .304 | n.s. |
| Perseverance Time (Seconds) | Mean | 740.7 | 697.3 | 671.4 | 565.5 | 449.1 | 535.7 | 580.5 | 941.4 | |
| | SD | 479.4 | 350.0 | 457.9 | 242.4 | 317.4 | 263.2 | 214.3 | 482.7 | n.s. |
| Rate (seconds per solution) | Mean | 64.69 | 69.73 | 61.42 | 58.90 | 51.62 | 58.17 | 56.80 | 75.31 | |
| | SD | 11.10 | 19.65 | 24.59 | 15.26 | 20.82 | 16.20 | 10.10 | 21.35 | n.s. |

N = Number of subjects
Note: See Table IV for Analysis of Variance

TABLE IV

ANALYSIS OF VARIANCE FOR PERFROMANCES WITH EACH TESTER ON COMBINED TASKS

| Dependent Variables | Source of Variation | df | Sum of Squares | Mean Squares | F Ratio | |
|---|---|---|---|---|---|---|
| Total Number of Solutions | Between Groups | 7 | 10.7 | 1.532 | | |
| | Within Groups | 183 | 4629.0 | 25.29 | .060 | n.s. |
| Number of Acceptable Solutions | Between Groups | 7 | 44.09 | .816 | | |
| | Within Groups | 183 | 2298.09 | 12.56 | .064 | n.s. |
| Efficiency Ratio | Between Groups | 7 | .416 | .0595 | | |
| | Within Groups | 183 | 10.995 | .06008 | .990 | n.s. |
| Perseverance Time (seconds) | Between Groups | 7 | 167088.95 | 23869.85 | | |
| | Within Groups | 183 | 3357136.18 | 18345.006 | 1.3011 | n.s. |
| Rate (seconds per solution) | Between Groups | 7 | 866.149 | 123.735 | | |
| | Within Groups | 183 | 67052.76 | 366.408 | .337 | n.s. |

Note: F Ratio .95, 7/120 df = 2.09

TABLE V

PERFORMANCES IN THE THREE REWARD CONDITIONS:
PEOPLE BLOCK TASK

| Dependent Variables | | No Reward | Pertinent Reward | Non-Pertinent Reward | |
|---|---|---|---|---|---|
| Total Number of Solutions | Mean | 5.24 | 5.45 | 5.71 | |
| | SD | 2.99 | 2.94 | 3.06 | n.s. |
| Number of Acceptable Solutions | Mean | 3.96 | 4.30 | 4.13 | |
| | SD | 2.27 | 2.27 | 2.65 | n.s. |
| Efficiency Ratio * | Mean | .799 | .826 | .734 * | |
| | SD | .245 | .274 | .288 | |
| Perseverance Time (seconds) | Mean | 345.7 | 336.4 | 398.6 | n.s. |
| | SD | 245.8 | 229.0 | 261.2 | |
| Rate (seconds per solution) | Mean | 66.90 | 62.79 | 69.44 | n.s. |
| | SD | 28.96 | 34.82 | 23.93 | |

* Differences between these means are significant $p < .05$

TABLE VI

PERFORMANCES IN THE THREE REWARD CONDITIONS:
WOOD BLOCK TASK

| Dependent Variables | | No Reward | Pertinent Reward | Non-Pertinent Reward | |
|---|---|---|---|---|---|
| Total Number of Solutions | Mean | 4.28 | 4.61 | 4.94 | n.s. |
| | SD | 1.83 | 1.87 | 2.32 | |
| Number of Acceptable Solutions | Mean | 3.37 | 3.97 | 3.40 | n.s. |
| | SD | 1.52 | 1.53 | 1.83 | |
| Efficiency Ratio * | Mean | .834 | .865 | .708 * | |
| | SD | .259 | .205 | .323 | |
| Perseverance Time (seconds) | Mean | 283.0 | 274.9 | 320.4 | n.s. |
| | SD | 191.9 | 166.7 | 204.4 | |
| Rate (seconds per solution) | Mean | 64.67 | 60.47 | 64.56 | n.s. |
| | SD | 26.15 | 30.47 | 24.29 | |

* Significance $p \leq .05$

Note: Significance of differences between means determined by analysis of variance.

TABLE VII

PERFORMANCES IN THE THREE REWARD CONDITIONS:
COMBINED TASKS

| Dependent Variables | | No Reward | Pertinent Reward | Non-Pertinent Reward |
|---|---|---|---|---|
| Total Number of Solutions | Mean | 9.71 | 10.36 | 11.02 |
| | SD | 4.74 | 4.79 | 5.56 |
| Number of Acceptable Solutions | Mean | 7.33 | 8.27 | 7.53 |
| | SD | 3.42 | 3.36 | 4.12 |
| Efficiency Ratio * | Mean | .802 | .830 | .702 * |
| | SD | .229 | .226 | .283 |
| Perseverance Time (seconds) | Mean | 628.7 | 611.3 | 719.0 |
| | SD | 401.1 | 353.5 | 415.4 |
| Rate (seconds per solution) | Mean | 63.93 | 58.30 | 65.55 ** |
| | SD | 21.05 | 17.74 | 20.14 |

* Analysis of Variance signif. $p < .01$

** Analysis of Variance signif. $p < .01$

Hypothesis 3, the Efficiency Ratio: The analysis of variance indicates that the effects of reward are operating in respect to this dependent variable which is computed for each subject by dividing the Number of Acceptable Solutions score into the Total Number of Solutions score. This variable is a measure of how effective the subject's activity is in providing solutions which meet the standards of acceptability provided in the initial phase of each experimental session. Such acceptability is not an arbitrary label but is logically appropriate to the task presented. The Non-Acceptable Solutions which were used were not based upon properties inherent in the sorting materials. In some cases the non-acceptable solution was one in which the tester could discern no criteria and the subject's explanation indicated that the grouping existed by his "fiat": "Because I put them that way," or simply, "Because." In other instances the Non-Acceptable sortings were based on some subjectively established relationship: "They are friends," or because of an inability, or unwillingness, on the part of the subject to group together objects which differ on several dimensions: "I made many groups because they are all different." Thus, this variable, the frequency of acceptable sortings relative to the total number of sortings, is an important indicator of the quality of behavior if one's aim is to assess a particular kind of cognitive activity.

Reward shows an influence upon the E Ratio on each task and on both tasks combined. Table VII, showing the effects of reward in both tasks (where this effect is significant beyond the .01 level), indicates that the No-Reward condition and the Pertinent Reward condition

both show a higher mean E Ratio value than the Non-Pertinent Reward condition.

Hypothesis 4, a) Perseverance Time: No significant differences were found on the length of time subjects in the three reward conditions stayed with the tasks.

b) Rate (Seconds Per Solution): This variable also shows no relationship to the reward conditions.

Hypothesis 5 was concerned with comparisons of the subjects who had SCIS in first grade with those who had the district science program. Both experience groups were somewhat equalized in the experiment by the screening task which determined that all tested subjects were able to perform the task. The teachers indicated that sorting activities are widely used with the children in the language-arts program.

a) Number of Acceptable Solutions: Table VIII indicates that the null hypothesis must be accepted.

b) E Ratio: This table also indicates that there are no significant differences between the two experience groups on this variable.

Hypothesis 6, Interaction of SCIS Experience and Reward Conditions: The analysis of variance indicates that there was an interaction of SCIS experience and Reward with respect to Rate. The means involved in this interaction are displayed in Table IX.

This table shows that under the Non-Pertinent Reward condition bo both groups have similar rates. However, in the No Reward condition, SCIS experienced subjects work quickly and the Non-SCIS subjects work slowly. Under Pertinent Reward, the SCIS subjects work slowly and the

Non-SCIS work quickly. Thus the effect of No Reward and of Pertinent Reward on Rate with each group is opposite. Since achievement in terms of the E Ratio does not differ for the two groups, these results suggest that, although reward conditions do not have an adverse effect on either group, the SCIS subjects may be disequilibrated by the rewards and slow down; but the No-SCIS subjects may be disequilibrated by the lack of rewards and also react by slowing down. Table X is an attempt to display the position of the SCIS and the No-SCIS subjects in each reward condition grouped dichotomously on both the E Ratio and Rate. The assignment of "Hi" versus "Lo" on Rate and E Ratio is made relative to the mean value of the variable for each group. It is interesting to note that all subjects, regardless of experience, work slowly and are "Lo" on efficiency in the Non-Pertinent Reward condition; but those who have not had SCIS, and therefore presumably less experienced at the task in question, work slowly and efficiently in the No-Reward condition!

Sex of Subject: Tables XI, XII, and XIII contrast the results for male subjects versus female subjects. Girls had a higher E Ratio than boys on the People Block Task (Table XI). Since this difference did not show up on the Wood Blocks, it would be difficult to explain this effect in terms of girls making use of a higher level of categorization. The nature of the cues for determining sorts on the People Blocks suggests an explanation. The higher relative achievement of girls may be due to social factors which train girls to have a greater perceptual sensitivity to details of dress or of the human figure.

TABLE VIII

PERFORMANCES ON COMBINED TASKS OF SUBJECTS WITH SCIS EXPERIENCE *vs* WITH NO SCIS EXPERIENCE

| Dependent Variables | | SCIS Experience | No SCIS Experience | |
|---|---|---|---|---|
| Total Number of Solutions | Mean | 10.61 | 10.31 | n.s. |
| | SD | 5.28 | 4.83 | |
| Number of Acceptable Solutions | Mean | 8.05 | 7.34 | n.s. |
| | SD | 3.55 | 3.71 | |
| Efficiency Ratio | Mean | .818 | .741 | n.s. |
| | SD | .220 | .274 | |
| Perseverance Time (seconds) | Mean | 649.2 | 655.9 | n.s. |
| | SD | 416.0 | 371.1 | |
| Rate (seconds per solution) | Mean | 61.35 | 64.02 | n.s. |
| | SD | 19.08 | 20.68 | |

Note: Significance of differences between means determined by analysis of variance.

TABLE IX

RATE (SECONDS PER SOLUTION) IN THREE REWARD CONDITIONS FOR THOSE WHO HAVE HAD SCIS AND FOR THOSE WHO HAVE NOT HAD SCIS FOR COMBINED TASKS

| SCIS Experience | | No Reward | Pertinent Reward | Non-Pertinent Reward |
|---|---|---|---|---|
| SCIS | Mean | 56.12 | 61.16 | 65.59 |
| | SD | 17.31 | 19.46 | 19.85 |
| No SCIS | Mean | 71.12 | 55.13 | 64.49 |
| | SD | 21.60 | 15.12 | 21.02 |

Note: Analysis of variance indicates a significant ($p < .05$) interaction on Rate between Reward Conditions and SCIS - other experience.

TABLE X

A COMPARISON OF SUBJECTS WHO HAVE HAD SCIS EXPERIENCE vs THOSE WHO HAVE NOT, CATEGORIZED ON BOTH "E RATIO" AND RATE IN THREE REWARD CONDITIONS

| Rate | "E Ratio" | |
|---|---|---|
| | Low Efficiency | High Efficiency |
| High (work slowly) | Non-SCIS<br>Non-Pertinent<br><br>SCIS<br>Non-Pertinent<br>Reward | Non-SCIS<br>No Reward<br><br>SCIS<br>Pertinent Reward |
| Low (work quickly) | | SCIS<br>No Reward<br><br>Non-SCIS<br>Pertinent Reward |

The interaction between sex of subject and reward conditions (Table XIII) on the E Ratio indicates that, although both boys and girls achieve about the same E Ratios in the No-Reward condition, girls do very well under the Pertinent Reward condition, and both boys and girls do poorly under the Non-Pertinent Reward condition. The very high performance of girls under Pertinent Reward suggests that the girls were able to use the rewards as feedback. The information value of Pertinent Rewards for girls was very effective in influencing their sorting behavior. Pertinent Reward had no effect one way or another for the boys.

Sex of Tester: The achievement of subjects working with male testers is compared with that of subjects working with female testers in Tables XIV and XV. Subjects working with male testers had higher E Ratios on both he People Block Task and the Wood Block Task. Perhaps the novelty of working with a man on a school task was factor here. A fact working against this explanation is that two of the elementary subject area specialists in the district are male. Since similar effects have been found in other reward research, and since it has implications for the school situation, this is a variable which should be given further attention.

Although there were these significant effects due to the sex of the subject and the sex of the tester, there were no significant interactions between sex of subject and sex of tester.

TABLE XI

PERFORMANCES OF MALE vs FEMALE SUBJECTS:
PEOPLE BLOCK TASK

| Dependent Variables | | Male Subjects | Female Subjects | |
|---|---|---|---|---|
| Total Number of Solutions | Mean | 5.80 | 5.13 | n.s. |
| | SD | 2.96 | 2.80 | |
| Number of Acceptable Solutions | Mean | 4.09 | 4.15 | n.s. |
| | SD | 2.37 | 2.43 | |
| Efficiency Ratio | Mean | .742 | .833 * | |
| | SD | .288 | .242 | |
| Perseverance Time (seconds) | Mean | 388.1 | 330.4 | n.s. |
| | SD | 269.6 | 229.9 | |
| Rate (seconds per solution) | Mean | 65.68 | 67.27 | n.s. |
| | SD | 24.97 | 33.59 | |

* Significant at $p < .05$

Note: Significance of differences between means determined by analysis of variance

TABLE XII

PERFORMANCES OF MALE vs FEMALE SUBJECTS:
WOOD BLOCK TASK

| Dependent Variables | | Male Subjects | Female Subjects | |
|---|---|---|---|---|
| Total Number of Solutions | Mean | 4.75 | 4.43 | n.s. |
| | SD | 2.10 | 1.93 | |
| Number of Acceptable Solutions | Mean | 3.59 | 3.53 | n.s. |
| | SD | 1.77 | 1.51 | |
| Efficiency Ratio | Mean | .778 | .828 | n.s. |
| | SD | .296 | .248 | |
| Perseverance Time (seconds) | Mean | 310.2 | 274.2 | n.s. |
| | SD | 210.5 | 162.0 | |
| Rate (seconds per solution) | Mean | 64.99 | 61.59 | n.s. |
| | SD | 30.13 | 23.09 | |

Note: Significance of differences between means determined by analysis of variance

TABLE XIII

MEAN "E RATIOS" ON COMBINED TASKS FOR MALE AND FEMALE SUBJECTS IN THREE REWARD CONDITIONS

| Sex of Subject | | No Reward | Pertinent Reward | Non-Pertinent Reward |
|---|---|---|---|---|
| Male | Mean | .740 | .722 | .609 |
| | SD | .235 | .272 | .306 |
| Female | Mean | .756 | .910 | .656 |
| | SD | .223 | .152 | .250 |

Note: The analysis of variance reported indicates:

| | |
|---|---|
| Reward Condition X Sex of Subject | signif. $<$ .01 |
| Reward Condition taken alone | signif. $<$ .01 |
| Sex of Subject taken alone | signif. $<$ .10 |

TABLE XIV

PERFORMANCES OF SUBJECTS WORKING WITH MALE TESTERS vs FEMALE TESTERS: PEOPLE BLOCK TASK

| Dependent Variables | | Male Testers | Female Testers | |
|---|---|---|---|---|
| Total Number of Solutions | Mean | 5.19 | 5.68 | n.s. |
| | SD | 2.61 | 3.24 | |
| Number of Acceptable Solutions | Mean | 4.26 | 4.01 | n.s. |
| | SD | 2.03 | 2.64 | |
| Efficiency Ratio | Mean | .844- | .742 * | |
| | SD | .199 | .307 | |
| Perseverance Time (seconds) | Mean | 329.8 | 382.2 | n.s. |
| | SD | 217.9 | 264.5 | |
| Rate (seconds per solution) | Mean | 63.52 | 68.70 | n.s. |
| | SD | 23.41 | 33.25 | |

* Analysis of variance significance $< .05$

Note: Significance of differences between means determined by analysis of variance

TABLE XV

PERFORMANCES OF SUBJECTS WORKING WITH MALE TESTERS vs FEMALE TESTERS: WOOD BLOCK TASK

| Dependent Variables | | Male Testers | Female Testers | |
|---|---|---|---|---|
| | | N = 83 | N = 108 | |
| Total Number of Solutions | Mean | 4.47 | 4.69 | n.s. |
| | SD | 1.88 | 2.13 | |
| Number of Acceptable Solutions | Mean | 3.83 | 3.36 | n.s. |
| | SD | 1.56 | 2.13 | |
| Efficiency Ratio | Mean | .868 | .752 * | |
| | SD | .214 | .304 | |
| Perseverance Time (seconds) | Mean | 269.5 | 310.4 | n.s. |
| | SD | 159.4 | 207.6 | |
| Rate (seconds per solution) | Mean | 60.75 | 65.32 | n.s. |
| | SD | 25.75 | 27.74 | |

* Analysis of variance significance $< .05$

Note: Significance of differences between means determined by analysis of variance

## Implications of the Findings

Although verbal reward is an important classroom variable both in terms of its place in almost all theories of learning and of its actual use as a teacher response to student activity, there has been very little done to study its function in real or simulated classroom conditions. The implications of the experimental literature that is available have been subject to serious methodological objections[8] and to cogent attack on the possibility of exterpolation of results to the classroom[9]. The present research set postulates which run counter to many of the positions taken on the use of reward in the classroom. It is clear from the present investigation that these positions, which are frequently stressed in teacher training[10], must give more careful attention to the relationship between verbal reward and the Task-recipient interaction. There are several important implications of a general nature in the present research.

In the first place, the nature of the experimental situation--so essential for the control of extraneous variables, where one adult worked with one child--is a situation which is in itself rewarding for the child. The fact that this did not wash out the important observed effects of the reward conditions indicates that verbal reward is a factor which has powerful effects upon the child and is one which must be most important in the classroom setting.

The second implication concerns the conceptual complexity of the tasks. The tasks chosen for the present study were of low conceptual complexity for the subjects tested. This fact is supported by the low number of subjects rejected by the preliminary screening task. It is

also supported by the generally high means achieved on the dependent variables. The People and Wood Block tasks were on different levels of stimulus complexity: the Wood Blocks involved rather gross discriminations; the People Blocks involved the perception of fine detail of a representative nature--that is, the outlines of dress and hair represented sex; the dots represented facial features, etc. The greater complexity of the stimuli led to an increase in the complexity of the cognitive activity involving the People Blocks. This part of the task problem was a more sensitive indicator of the treatment conditions and also of the other independent variables. This suggests that the next step in this research is to increase the level of task complexity in order that the treatment conditions on reward may become more salient. This initially should be done with subjects on a similar socio-economic level.

This last point brings up another phase extending the present research. The socio-economic homogeneity of the population tested gave the methodological advantage of controlling several variables which might have masked the experimental effects had they not been controlled. Another advantage is that the present study supplied a good base line in that the tasks used show a certain level of complexity with one socio-economic group. To take full advantage of this fact it is important to replicate the study on various socio-economic levels. It may prove necessary to adjust the difficulty of the tasks with other groups. It seems likely that the reward variables would function as they did with this test population and, with the adjustment of the task complexity, the effects should be even more apparent.

The fact that children using the SCIS program with teachers trained in low reward procedures showed a different susceptibility to reward conditions is also very interesting. The equivalency of the two prior experience groups on the experimental task was provided by the screening task and verified by the task competency measures. Therefore the rate differences of the two experience groups under the different reward conditions is an effect that deserves further investigation.

The belief is often expressed that the personality of the teacher is a most important factor in motivating pupils to greater achievement in the classroom. In the present study there was concern that the reaction of the children to the various personalities of the testers would be more important for achievement (e.g., for perseverance time) than anything the tester could say over such a short period of time. The fact that no differences could be detected in the dependent variables across testers indicates that this factor was not an important one in the present study.

## The Effects of Reward

The conclusion seems justified, on the basis of the data reported in this study, that the use of verbal rewards which are not congruent with behavior will result in less efficient problem-solving than either a neutral, no-reward situation, or the use of rewards which are congruent with the problem-solving behavior. The giving of rewards which are congruent improves the problem-solving efficiency of girls but not of boys.

## Implications for Research and Application

To what extent are these findings applicable to the classroom? The answer to this question depends upon the recognition that the present study represents the first phase of a multi-phase research effort. Some of the steps in this series have been detailed above. The next major phase of this research should be the determination of results in small groups of three or four subjects. The work of Sechrest[11] suggests that the effects of reward or punishment upon the non-rewarded member of a dyad is greater in some cases than the effect upon the recipient. This is backed up by the work of Kounin, Gump, and Ryan[12] who observed the effects of verbal punishment in classrooms. Therefore, it is important to design a follow-up study which will analyze the effects of verbal reward in a situation where there is the possibility of interaction between subjects. When this step has been taken, then we will be able to make application to the classroom and to provide the teacher with solid advice on how and when to use verbal reward in order to achieve classroom objectives.

At the moment, using the data of the present study, there is reason to say that a neutral, no-reward condition and congruent, pertinent reward produce more efficient behavior than the type of non-congruent, non-pertinent reward which marks current classroom practice. Perhaps some attention should be paid right now to the differential effect of reward on boys and girls; congruent reward appears to act as useful feedback for girls. Certainly, the Non-Pertinent pattern is to be challenged, and when the effect of rewards in the group situation is known, then we may want to be even more conservative in science classes on the use of evaluative responding.

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